ORIGINAL ARTICLE

Effect of ‘mHealth’ Interventions on adherence to treatment and outcomes in Tuberculosis patients of district Shimla, Himachal Pradesh, India: A Randomised Control Trial

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ABSTRACT

Background: Of all cases of Tuberculosis worldwide, India bears the major burden. Application of Mobile technology can prove to be a boon in complementing patient centric approach in otherwise hard to reach areas. This study envisaged to study the effects of ‘mHealth’ interventions in TB patients a district with tough terrain but excellent literacy rates and a very high tele-density. Methods: A Randomized controlled trial design was adopted to study the effectiveness of ‘mHealth’ interventions in the form SMS reminders and voice calls. The intervention arm received the messages in ‘Devanagri’ script of the national language ‘Hindi’ on their scheduled days of treatment and follow-up. Educational and reminder messages were also sent. Queries related to all aspects of treatment were received by the investigators through an advertised mobile number. Patients enrolled in the comparison group were followed as per the usual DOTS program till completion of treatment. The groups were compared in terms of treatment outcomes and number of doses and follow ups missed. Results: Out of the 312 patients enrolled for the study, risk of adverse outcomes was 43% statistically lower in intervention group as compared to control group (OR; 95% CI: 0.57 (0.35-0.96)). Also the risk of >10% of missed doses of treatment was 67% lower in intervention group (OR; 95% CI: 0.33 (0.12-0.90)). Risk of missing more than two follow ups was 50% lower in intervention group. Conclusions: The study helps to build further evidence about the effective use of mobile technology in strengthening patient centric approach in TB management particularly in difficult to access areas. Software with system generated reminders incorporated into the existing NIKSHAY portal can be formulated to facilitate adherence. Availability of a dedicated “Counselling service” using voice calls may be incorporated to address patients’ queries which will help improve adherence ultimately contributing to favourable outcomes.

Key Words: mHealth, Tuberculosis, Community mobilization, DOTS

Introduction

Tuberculosis control has been a long fought battle since the discovery of Tuberculosis bacilli by Robert Koch some 125 years ago. The World Health Organization (WHO) declared Tuberculosis (TB) a global public health emergency in 1993 and since then intensified its efforts to control the disease worldwide.1 Tuberculosis remains a worldwide public health problem despite highly effective drugs and vaccine being available.
TB is the ninth leading cause of death worldwide and the leading cause from a single infectious agent, ranking above HIV/AIDS. In 2016, there were an estimated 1.3 million TB deaths among HIV negative people (down from 1.7 million in 2000) and an additional 3,74,000 deaths among HIV-positive people. An estimated 10.4 million people (90% adults; 65% male; 10% people living with HIV) fell ill with TB in 2016 (i.e. were incident cases). Most of the estimated number of incident cases in 2016 occurred in the WHO South-East Asia Region (45%), the WHO African Region (25%) and the WHO Western Pacific Region (17%); smaller proportions of cases occurred in the WHO Eastern Mediterranean Region (7%), the WHO European Region (3%) and the WHO Region of the Americas (3%). The top five countries, with 56% of estimated cases, were (in descending order) India, Indonesia, China, the Philippines and Pakistan.

India accounts for one fourth of the global TB burden. In 2015, an estimated 2.8 million cases occurred and 0.48 million people died due to TB. Major challenges to control TB in India include poor primary health-care infrastructure in rural areas of many states; poor counselling and education leading to defaults and poor outcomes, unregulated private health care leading to widespread irrational use of anti-TB drugs and spreading HIV infection. Multidrug-resistant TB (MDR-TB) is another emerging threat to TB eradication and is a result of a deficient or deteriorating TB control program. Tuberculosis (TB) is nearly always curable if the patients are treated with effective and uninterrupted anti-Tuberculosis therapy. The paramount goal of TB-control programs is to ensure that TB patients complete their prescribed course of therapy. Besides DOTS, education and counselling on various aspects of the disease and treatment is vital in improving the adherence to treatment and ultimately in improving the treatment outcomes. A patient who is not counselled and educated about the infection/disease is at a higher risk of defaulting, becoming re-infected, spreading the infection to the community and becoming drug resistant.

Shimla is the third most populous district of Himachal Pradesh (out of 12), after Kangra and Mandi with a population of 8,55,613 out of the total state’s population of about 69 lakhs. It is also the most urbanized district of Himachal Pradesh. As per the 2011 census, the aggregate male and female literacy rates were 95.75% and 93.35% respectively.

Wireless technologies now cover 96% of the global population and penetrate all walks of life. With 6.8 billion mobile subscriptions worldwide, the technology has successfully bridged the gaps in communication and has ignited economic growth and development globally. “mHealth” i.e. The use of mobile and wireless technologies to support the achievement of health objectives is the emerging promising modality in healthcare for better treatment compliance, health promotion and community mobilisation and is currently being researched and implemented globally. Mobile based interventions have been increasingly used to improve a broad range of health outcomes. Himachal Pradesh has achieved the distinction of being one of the first states in India to have more mobile subscriptions than the total population. Presently, H.P has a tele-density of about 108% which is much higher than the overall country tele-density of 74% with a total of more than 70 lakh subscribers. Mobile technology can be used as a low cost intervention in the study setting keeping in view the high tele-density and excellent literacy rates in Himachal Pradesh.

The present study envisaged evaluating the various factors influencing treatment outcomes and the effect of education and counselling (using ‘mHealth’ interventions) on adherence and outcomes in the patients suffering from Tuberculosis as no study had been done in this part of the country regarding the same so far.

Objective

To assess the effect of ‘mHealth’ interventions on adherence to treatment in patients of Tuberculosis on category I DOTS.
Methodology

Study design: It was a Randomised Control Trial. All the newly diagnosed patients of Tuberculosis put on treatment in the last quarter of 2016 in district Shimla who fulfilled the inclusion criteria were enrolled randomly into the intervention and control group.

Intervention group: Patients enrolled into the intervention group received SMS reminders in addition to usual DOTS therapy till the treatment was completed.

Comparison group: Patients enrolled in the comparison group did not receive any SMS and followed the usual DOTS program till the treatment completion.

Sampling

Sample size:

- \( P_1 = 0.85 \) (85% treatment success rate)
- \( p_2 = 0.95 \) (95% treatment success rate)
- 80% POWER
- 95% CI
- Formula: \( \frac{C \times e_x \times \left( \frac{p_1 (1-p_1) \times p_2 (1-p_2)}{(p_1 - p_2)^2} \right)}{1} \)
  
  (Where \( c = 7.9 \))
- Sample size = 284 + 10% non-participation
- Final Sample size: 312

Sampling technique: After calculating the sample size, the patients of the selected TUs were randomly allotted to the intervention and control group as per computer generated randomization. Enrolment was done as per the pre-decided randomization groups generated and patients were enrolled who fulfilled the inclusion criteria.

Inclusion criteria

1. Newly diagnosed Category I Tuberculosis patients on DOTS who consented for the study.
2. Had a mobile phone and able to read the SMS (patient or close companion).
3. Permanent resident of the area.
4. Willing to receive SMS and calls on the mobile phone.

Exclusion criteria

1. Cases already diagnosed with Human immunodeficiency virus infection or on steroids.
2. Seriously ill patients.

Study duration

The study was completed in 12 months (October 2016 - September 2017).
**Effect of 'mHealth' interventions on adherence to treatment and outcomes of TB patients**

156 newly diagnosed TB patients

156 newly diagnosed TB patients

SIX MONTHS

DOTS

DOTS + SMS

CURED + TREATMENT COMPLETED (proxy for adherence)

CURED + TREATMENT COMPLETED (proxy for adherence)

**Enrolments**
- Assessed for eligibility (n=a)
- Newly registered TB cases put on Cat I DOTS
- ≥10 years of age
- Pt. or close associate have mobile for personal use
- Know how to open and read SMS

**Allocations**
- Allocate to SMS intervention arm: (n=b)
- Control arm (n=d)

**Follow-up**
- Dose reminders
- Sputum follow-up date reminders
- Education regarding disease
- Education regarding side effects and action to be taken
- Regarding importance of adherence
- Regarding nutrition
- Regarding following timelines
- Early contact tracing

**Analysis**
- Lost to follow-up (n=x)
  - Desertion, missing data, transferred out, died etc.

**Study duration**

The study was completed in 12 months. (October 2016- September 2017)
- 3 months to recruit participants – Patients enrolled in q4 2016.
- 6/7 months for participant follow-up.
- 3 months for data analysis and report writing

**Enrolments**
- Exclude (n= c)
  - Seriously ill
  - Decline to participate

**Regular monitoring as per RNTCP protocol**

**Comparative analysis** (b-x) vs. (d-x) At the outcome on:
- Cure
- Treatment completion
- Adherence
- Default
- Failure
- Following timelines
Study Area

The study was conducted in 8 Tuberculosis units of district Shimla of Himachal Pradesh after comparing the geographic, socio demographic, literacy backgrounds and the unfavourable outcome records from the RNTCP. Outcome was assessed in terms of treatment success (cured + treatment completed) and unfavourable outcome (default, failure and death rates).

**Intervention:** They intervention arm subjects received daily SMS reminders in Hindi language under the ‘HEAL-TB’ banner. The protocol of sending the SMS was same as the treatment schedule and messages was sent on the same day morning of the scheduled DOTS day. All category I patients received SMS for 6 months. In case the treatment was prolonged due to failure, the SMS duration covered the extended period. The content of the SMS messages sent was as under:

- Dose reminders on Mondays, Wednesdays and Fridays
- Investigation reminders on scheduled days
- Educational regarding disease and side effects of drugs on Sundays
- Nutrition on Sundays

An example of a dose reminder is “नमस्कार! आज आप का डॉट्स की दवाई लेने का दिन है 1 छपथा सबक या और नियमित रूप से दवा से तापमान अप की वीयरी उड़ से बढ़ने हो जाने एवं बिल्कुल अप को न फेला. सम्बंधित जानकार के लिए संपर्क कीजिये: 9418224000 धन्यवाद.”

Confirmation on dose intake was taken from the DOTS providers. Participants also received messages on the importance of completing the treatment, about the minor side effects they faced during the course of the treatment and regarding nutrition. At the end of treatment they were congratulated for their support and cooperation. Besides this they were monitored as per the routine RNTCP protocol.

**Comparison group**

Information on the socio-demographic variables was obtained. The intervention and control groups were age and sex matched. Participants in the control group will not receive any message or calls. They will get treatment from DOTS provider as usual. Other outcomes will also be measured on same parameters.
Study tools
- Semi-structured pretested schedule on various socio demographic variables
- Secondary data from the TB registers

Data Collection: The Office of the District Tuberculosis Officer and the TUs was visited in the last week of September 2016 for the requisite permissions and a preliminary rapport building with the RNTCP staff. After the registration of the patient for initiation of DOTS, data for socio-demographic characteristics/type of disease/treatment was collected. Primary data was collected by the investigators by interviewing after taking informed consent. Regular reminders were continued till the completion of treatment schedule of the last patient enrolled in the study. The investigators visited each DOT centre once in a week during intensive phase and once in a fortnight during continuation phase to collect data regarding adherence to the treatment by contacting the DOTS centre/providers.

Randomization and Masking: Once a patient consented to participate, a study representative entered identifying information on a mobile phone-based enrolment form. Individual participants were randomized to either the ‘HEAL TB’ SMS or control groups, using predetermined list on the study server that was generated using simple randomization. The research team was blinded to the allocation sequence generated.

Data analysis: Data was entered into Microsoft Excel software and analysed using SPSS 21.0 Version.

Ethical Considerations: The study was conducted after review and approval by the RNTCP State Task Force. The trial was registered under the Clinical Trials Registry of India vide No. REF/2016/12/012782 (H) after obtaining due permission from the Institutional Ethics committee. All data collected during the study was kept confidential and was accessible to only the study investigators. The electronic data records were secured properly through a password protection key.

Results
Age and Gender distribution: Out of the 312 patients enrolled for the study, majority of the participants were in the 20-39 years age group (60% cases vs. 54.5% controls). The mean age of the intervention group was 37.78 (±12.66) years and the control group was 37.8 (±12.8) years. Out of the participants a major proportion (60% cases vs. 55% controls) was males.

Locality wise distribution of study population: Most of the participants belonged to urban areas in both the study groups (74% and 72%). Majority of participants in both the groups were educated up to the secondary level (51% cases Vs. 43.6% controls) followed by graduation and above (20% cases and 24.4% controls).

Occupation wise distribution of study population: Most of the study participants in the intervention arm were employed (48%) as compared to 28% of the control arm.

Type of Tuberculosis diagnosed: Majority of the study participants in both the groups were diagnosed as patients of Pulmonary Tuberculosis (69% and 70% respectively). Around 80% of PTB cases were bacteriologically confirmed both in intervention and control groups and most of the extra pulmonary TB cases were clinically diagnosed.

Distribution of TB patients by the type of substance used: A larger proportion of the study participants in both the age groups were non-smokers and non-alcoholics.
Distribution by HIV and Diabetes Status: Around 4.5% in intervention arm and 5.7% in control group were HIV positive while there were 10.3% and 6.4% diabetics in the two groups respectively.

Treatment outcomes of the patients as per WHO recommendations: The proportion of more than 10% missed scheduled doses was observed to be higher in control group (10%) as compared to intervention arm (3.2%). Similarly more than two follow up visits were missed by 7.6% control arm patients as compared to 3.2% intervention arm patients. Favourable outcome in intervention arm was 86% as compared to 76% in control arm. (Table 1)

Table 1: Treatment outcomes of the patients as per WHO recommendations

<table>
<thead>
<tr>
<th>Outcome variable</th>
<th>Intervention (n=155)</th>
<th>Controls (n=156)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>No. of Doses Missed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nil</td>
<td>133</td>
<td>85.8</td>
</tr>
<tr>
<td>Up to 10% of the scheduled doses</td>
<td>17</td>
<td>11.0</td>
</tr>
<tr>
<td>More than 10% of the scheduled doses</td>
<td>5</td>
<td>3.2</td>
</tr>
<tr>
<td>No. of Follow Ups Missed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nil</td>
<td>142</td>
<td>91.6</td>
</tr>
<tr>
<td>Up to 2 follow ups</td>
<td>8</td>
<td>5.1</td>
</tr>
<tr>
<td>&gt;2 follow ups</td>
<td>5</td>
<td>3.2</td>
</tr>
</tbody>
</table>

RNTCP Outcome

<table>
<thead>
<tr>
<th>Adverse Outcomes</th>
<th>Intervention</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>Defaults</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Deaths</td>
<td>1</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Favourable Outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Intervention</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cured (Bacteriology confirmed)</td>
<td>78</td>
<td>70</td>
</tr>
<tr>
<td>Treatment completed</td>
<td>56</td>
<td>49</td>
</tr>
</tbody>
</table>

The risk of adverse outcomes was 43% statistically lower in intervention group as compared to control group (OR: 95% CI: 0.57 (0.35-0.96)). Also the risk of >10% of missed doses of treatment was 67% lower in intervention group (OR: 95% CI: 0.33 (0.12-0.90)). Risk of missing more than two follow ups was 50% lower in intervention group. However, it was not statistically significant (Table 2).
Table 2: Association of the Study and Control Arms with the outcome variables

<table>
<thead>
<tr>
<th>Outcome Variables</th>
<th>Exposure Group</th>
<th>Relative Risk (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adverse Outcomes</td>
<td>Control Group</td>
<td>1</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>Intervention Group</td>
<td>0.57 (0.35-0.96)</td>
<td></td>
</tr>
<tr>
<td>Doses missed</td>
<td>Control Group</td>
<td>1</td>
<td>0.04</td>
</tr>
<tr>
<td>Missed any Scheduled doses</td>
<td>Intervention Group</td>
<td>0.61(0.38-0.99)</td>
<td></td>
</tr>
<tr>
<td>Missed &gt;10% of the scheduled doses</td>
<td>Control Group</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intervention Group</td>
<td>0.33 (0.12- 0.90)</td>
<td></td>
</tr>
<tr>
<td>Follow ups missed</td>
<td>Control Group</td>
<td>1</td>
<td>0.02</td>
</tr>
<tr>
<td>Missed &lt; 2 follow ups</td>
<td>Intervention Group</td>
<td>0.48 (0.25-0.90)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intervention Group</td>
<td>0.50 (0.17-1.43)</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Discussion

In the present study of a total 312 patients were enrolled using inclusion criteria, participants were randomly allocated to the intervention and control groups after matching for age and sex. After the loss to follow-up of one patient, there were 155 and 156 participants in the intervention and control groups respectively.

Socio-Demographic Profile of the patients

**Age distribution:** Tuberculosis mostly affects adults in their most productive years. However, all age groups are at risk.\(^{12}\) It is common to see a J-shaped curve of TB incidence rates by age, with higher rates in younger children from infancy to pre-adolescence. Rates increase abruptly during the adolescent years and remain high throughout adulthood, with a tendency to increase as the age progresses.\(^{13}\)

The present study has observed the maximum proportion of cases to be in the 20-39 age group (60% cases vs. 54.5% controls) which corresponds to the global averages.

**Gender distribution:** The male to female ratio of TB cases reported to the WHO is around 1.5-2.1 in all regions of the world (WHO 2000). TB prevalence is significantly higher among men than women in low- and middle-income countries.\(^{14}\) In the present study too, males constituted a major proportion (60% cases vs. 55% controls). Historically, the excess of notified cases among men has often been explained as a result of barriers faced by women in seeking care for and being diagnosed with TB. The years complemented by enhanced literacy, awareness and diminished stigma leading more women to seek treatment early and hence the improved notification rates.\(^{15,16}\)

**Educational level:** TB incidence has been observed to decline more quickly in countries that had a higher human development index.\(^{17}\) A systematic literature review on Tuberculosis and socioeconomic indicators carried out in 2012 found direct statistical association between Tuberculosis and low educational level.\(^{18}\)

The present study observed the disease distribution across all levels of education attainment ranging from 11.3% and 14.7% of illiterates in the intervention and control groups respectively. Those with graduation and above constituted 31% and 38% in the intervention and control groups respectively.

**Area of residence:** Rapid urbanization can create ideal conditions for TB epidemics to flourish and TB incidence is generally found to be higher in urban than in rural areas.\(^{19}\)

The present study observed that 71.4% of the patients in the intervention group and 69.2% of the patients from the control group belonged to urban areas.
Occupational status: The occupational risk of Tuberculosis is the probability of acquiring Tuberculosis infection or active TB as a result of coming in contact with (1) people who have infectious TB or (2) air that contains Mycobacterium Tuberculosis.

In the present study, most of the study participants in the intervention group were employed (48%) as compared to 28% of the control group.

Socio-economic classification: Poverty is both a cause and consequence of Tuberculosis. When a poor person has TB, he/she spends his money and time to get well. This could lead to the loss of livelihood because of having to spend excessive time absent from work, resulting in less money earned and less spent on food and nutrition. Consequently, nutritional deficiency further erodes health and increases the potential for re-infection. Many studies conducted outside India have confirmed the positive association between poverty indicators and Tuberculosis.

The present study has observed the highest proportion of patients to be from the Middle socio-economic class (43.6% in the intervention group and 42.2% in the control group).

Type of TB: The present study has observed the distribution of Pulmonary TB to be 68.9% in the intervention group and 70.5% in the control group. Among the Pulmonary TB cases, the study found the proportion of bacteriologically confirmed cases to be 80.4% and 84.1% in the intervention and control groups respectively.

The global estimate of extra pulmonary TB (EPTB) ranges from 17% to 52% of all cases of TB. It is estimated that Extra-pulmonary TB (EPTB) constitutes 15 to 20 per cent of Tuberculosis cases in general practice among Immuno-competent adults in India. Various international and national studies have found the distribution of EPTB to be around 49.4%, 20%, and 41.6%.

The present study has found the proportion of Extra-pulmonary TB to be 31.1% in the intervention group and 29.5% in the control group. Out of the EP-TB cases diagnosed, bacteriologically confirmed cases were 10.4% and 8.7% in the intervention and control groups respectively.

Tobacco and Alcohol use: Various studies in India and abroad have concluded that smoking roughly doubles the risk of tuberculous infection, active TB disease and death.

The present study has found the proportion of Tobacco users to be 22.6% in the intervention group and 28.8% in the control group. No significant associations were noted between smoking status and the type of TB.

Prevalence of alcohol use disorders among TB patients have ranged from 10% to 50% as per various international and a recent Indian study.

The present study has observed the proportion of alcohol use to be 17.4% in the intervention group and 19.3% in the control group. However, no significant associated was noted between alcohol use and the type of TB.

Comorbidty (HIV and Diabetes Mellitus): The association between diabetes mellitus and tuberculosis and their synergistic role in causing human disease has been recognised for centuries. Historically, the incidence of tuberculosis in patients with diabetes has been high. A recent study from India has reported the prevalence of diabetes in tuberculosis patients to be as high as 29%.

The present found that around 4.5% in intervention group and 5.7% in control group were HIV positive while there were 10.3% and 6.4% diabetics in the two groups respectively.
Treatment Outcomes

The treatment success rates in the intervention group (86.4%) and control group (76.2%) and in concordance with recent studies in India have reported treatment success rates of 83.4% and 85.5% respectively.35,36 However, they fall short of the global priority indicators and targets for monitoring the implementation of the End TB Strategy (2015-2025) which have set the target of achieving 90% treatment success rate.37

Association of the Study and Control Arms with the Outcome Variables

Factors influencing treatment outcomes

Adherence to treatment: In terms of TB control, adherence to treatment may be defined as the extent to which the patient's history of therapeutic drug-taking coincides with the prescribed treatment. Tuberculosis (TB) is nearly always curable if patients are treated with effective, uninterrupted antituberculous therapy. Adherence to treatment is critical for cure of individual patients, controlling spread of infection, and minimizing the development of drug resistance.

In the present study, the risk of missing >10% doses was 67% lower in intervention group (OR; 95% CI: 0.33 (0.12-0.90)). Risk of missing more than two follow ups was 50% lower in intervention group. However, it was not statistically significant.

mHealth: Mobile health (mHealth) is a promising means of improving adherence to medication thereby potentially improving clinical outcomes.38 In the present study, the automated system named ‘HEAL TB’ successfully delivered a total of 24,356 messages to the 115 intervention group individuals as per the predetermined schedule.

A two-arm, parallel design, effectiveness randomized controlled trial was conducted in Pakistan from 2011-13 to measure the impact of ‘Zindagi SMS’, a two-way SMS reminder system, on treatment success of people with drug-sensitive Tuberculosis. The trial found no significant difference between the ‘Zindagi SMS’ or control groups for treatment success (719 or 83% vs. 903 or 83%, respectively, p = 0.782).39 A systematic review done in 2015 by Sarkar S, Sivashankar S and Seshdri S concluded that SMS reminders offer a promising intervention for improving medication adherence. This has a special appeal for developing countries which has seen rapid development of telecommunication facilities, and growing access to mobile phones.40

In the present study, the risk of adverse outcomes was 43% statistically lower in intervention group as compared to control group (OR; 95% CI: 0.57 (0.35-0.96) which corresponds to the 67% lower risk of missing >10% doses in the intervention group (OR; 95% CI: 0.33 (0.12-0.90). The study incidentally observed that the patients’ attendants were concerned and curious about their kin’s health as was evident from the 87 calls received by an investigator from the group. Most common queries were related to adverse effects, missed doses, schedule of treatment and followup concerns.

The study reiterates the fact that excellent adherence is the cornerstone in the control of Tuberculosis. Excellent adherence to treatment ultimately leading to lesser adverse treatment outcomes observed in the intervention group as compared to the control group can be attributed to complementing of the robust national programme by SMS reminders and counselling through interactive voice calls.

Limitations: The present study was confined to district Shimla only. Generalizability to the whole state, region and country may be a limitation owing to varying socio-cultural literacy status and varying tele-density. Further multi-centric studies are warranted to establish the associations.
Recommendations

1. ‘mHealth’ technology seems to be an effective intervention for reducing missed doses thus achieving favourable outcomes. Software with system generated reminders incorporated into the existing NIKSHAY portal and sending them to all patients with mobile phones can be formulated to facilitate adherence.

2. Availability of dedicated ‘Counselling service’ (which has been observed to be the felt need of the beneficiaries) using voice calls may be incorporated in the existing programme structure to address patients’ queries which will help improve adherence ultimately contributing to favourable outcomes.

3. A multi-centric study with different cultural backgrounds will strengthen the validity of the study.

References


6. The official website of district Shimla. Available at http://hpshimla.nic.in/.


